Space Weather Technical Forecast

Issued on Friday, 13 January 2023 at 05:49 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-class flares (R1-R2 radio blackouts) expected. Chance of X-class (R3 radio blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the last 24 hours, with a M1.5 at 12/0652UTC from AR3186 (Ehi/beta-gamma) which is the largest region on the visible disc, and a M1.1 flare from AR3181 (Eki/βγ) at 12/1128 UTC. There are four further numbered sunspot regions on the visible disc, of which AR3184 (Fki/beta-gamma-delta) has the greatest magnetically complexity, although AR3182 also relatively complex with a Eki/beta-gamma classification. The remaining regions are small, weak and magnetically simple, including one unnumbered region in the northwest. There is another unnumbered region on the disc, currently rotating onto the southeast limb, and appears to be a large region with penumbra, but there is potential for a large and complex region to emerge from the far side. Several CME's have occurred through the period, but currently none are thought to be Earth directed.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by DSCOVR at L1, persisted at slightly elevated levels, generally between 400-440km/s, under the residual influence of a high speed stream from coronal hole 6. The solar wind peaked at 464 km/s at 12/1349 UTC. Density continued at average levels. Total magnetic field strength was predominantly at weak levels throughout, varying between 7nT and 9nT. The north-south component has varied between weak positive and negative values throughout, reaching -8 nT at 12/1313 UTC. Phi angle was remained negative (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 was mostly at background levels. High energy electron flux (greater than 2 MeV) was at background to moderate levels, peaking at 202 pfu. The 24-hour integrated electron fluence stayed well below the Active threshold on a generally steady trend, reaching 2.7e6 integrated pfu at 12/2359 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity expected to remain at Moderate levels with occasional M-class flares, and a chance of X-class flares, due to a number of complex active regions on the visible disc.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently expected, although a CME which left the Sun on 09 January could give a glancing blow at Earth early today, but this is a low probability and low confidence. Solar wind speeds are currently around 400km/s due to a weak residual connection to coronal hole 62, and are likely to remain at background to slightly elevated levels. No further coronal holes are expected to connect with Earth during the forecast period. Geomagnetic activity is expected to be Quiet to Unsettled (Kp 1-3), although there is a slight chance of Active (Kp 4) intervals early today due to the possible pact of a CME.

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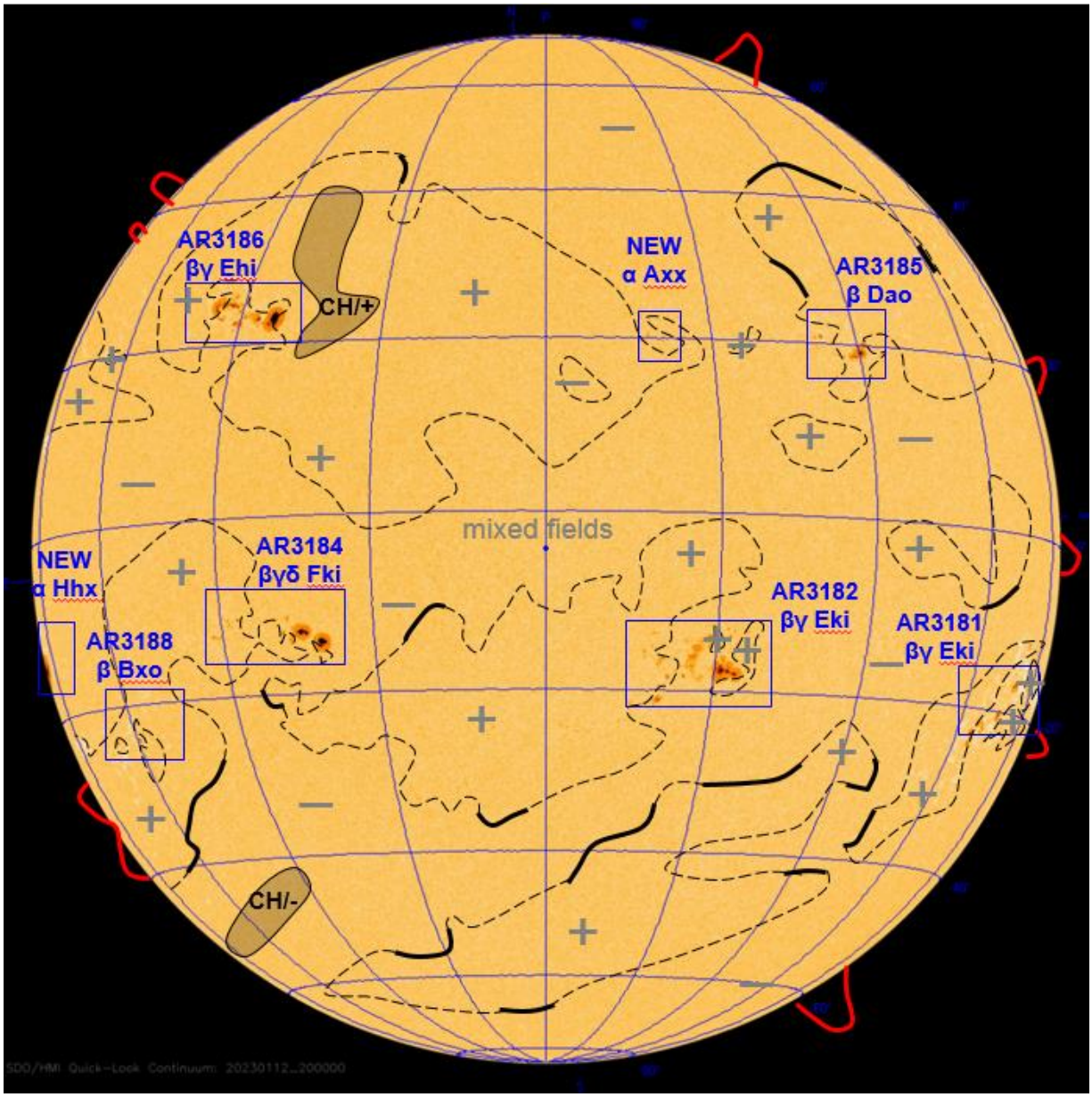
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES-16 is likely to remain at predominantly background to slightly elevated levels, but has started day 1 (13th) with an increase from background levels, although still remains well below the S1/Minor Storm threshold. As there are various complex regions in the western hemisphere so there is an increasing risk of the S1/Minor Storm being reached, should any significant flares occur. The high energy electron flux (greater than 2 MeV) is expected to persist at background to moderate levels, with the corresponding electron fluence remaining below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 12/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

No Earth-directed CMEs are currently expected, although a CME which left the Sun on 09 January could give a glancing blow at Earth early today, but this is a low probability and low confidence.

Solar wind speeds are currently around 400km/s due to a weak residual connection to coronal hole 62, and are likely to remain at background to slightly elevated levels as the high speed influence continues to decline. No further coronal holes are expected to connect with Earth during the forecast period.

Geomagnetic activity is expected to be Quiet to Unsettled (Kp 1-3), although there is a slight chance of Active (Kp 4) intervals early today due to the possible a glancing impact of the CME.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X-Ray Flares:

There are six numbered sunspots on the visible disc and two unnumbered regions. AR3184 is now the most complex region on the disc, with a delta region, and has increased slightly in spot number. AR3181 remains a beta-gamma region, but has shown recent decrease in area and spot number. AR3185 remains a Dao, but the penumbra on the trailing spots has decreased to become rudimentary. AR3182 is also large, with a Eki/beta-gamma classification, with a recent slight increase in penumbra on some small trailing spots. AR3186 doesn't appear to currently have a delta spot, although the analysis is marginal. The region has shown continued slight growth in area and spot number, and remains a complex beta-gamma. AR3184 has delta region, and has increased slightly in spot number. AR3188 remains small and simple, and has developed some rudimentary penumbra on the trailing spot. A new region is currently emerging on the SE limb, and appears to be a large with penumbra, but could fully emerge to become a significant region.

Solar activity has been Moderate with the largest flare a M1.5 flare from AR3186 at 12/0633UTC. This region has been responsible for the most significant flares over the last 24 hours, which aligns with the recent complex developments observed within the region. In addition to AR3186, AR3181 and AR3182 and AR3184 are the most likely regions to produce further flares. Further M-class flares are expected, with a continuing chance of X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)

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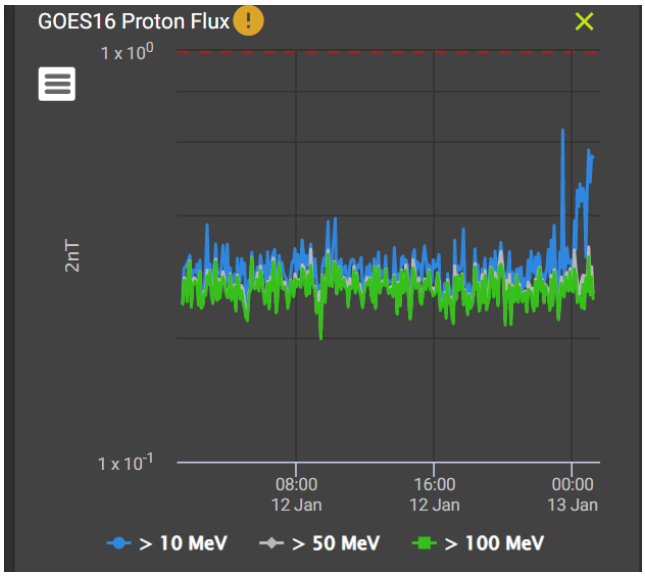
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	20	20	20	20

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10 MeV) proton flux observed by GOES-16 has started day 1 (13th) with an increase from background levels, although still remains well below the S1/Minor Storm threshold. As AR3181 and AR3182 are both in the western hemisphere, and are complex regions, so there is an risk of the S1/Minor Storm being reached throughout the period, although AR3181 will rotate off to the far side later today or early tomorrow.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	40	40	30	30
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 2: Latest GOES16 Proton Flux



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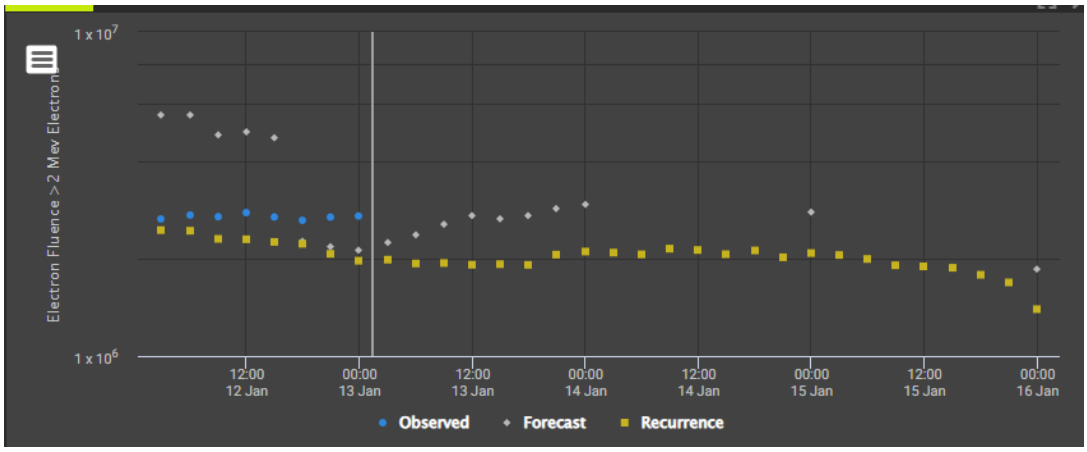
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to vary between background to moderate levels under the residual weak influence of a high speed stream from CH62, with significant distortion of the belts unlikely. The possible CME arrival could lead to a slight depression in the electron flux, followed by a limited increase.
Electron fluence values are expected to remain below the Active threshold, with no significant impact on electron counts through the period. Therefore the Met Office REFM model is considered to be offering good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: Met Office REFM model



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